

thus no longer exists.

The Examiner indicated that claims 47 and 58 are seen as substantial duplicates, and would not both be allowed on the ground of double patenting. Applicants have now cancelled claim 47, thus obviating this concern.

The Examiner has rejected claims 1-61 under 35 USC § 103(a) as being allegedly obvious over Klos in view of a technical journal article by Bourke et al. (hereinafter "Bourke"). This rejection is respectfully traversed, and is addressed with respect to each of the pending independent claims below.

Regarding independent claims 1, 14, 20 and 24, each of these claims recites that the conversion layer presents a corrosion protection "of about 100 to 1000 h in the salt spray test according to DIN 50021 SS or ASTM B 117-73 until first attack according to DIN 50961 Chapter 10." It has already been agreed by the Examiner, e.g. during a telephone interview conducted October 9, 2002, that Klos does not disclose or suggest such a conversion layer. See Examiner interview summary, part of Paper No. 14: "Hence, it was agreed that the Klos patent does not teach, suggest or disclose conversion coatings on zinc-base or cadmium-base surfaces having at least 100 hours of corrosion resistance in a standard salt spray test."

In further distinction of Klos, Applicants note that the degree of corrosion protection for a chromate conversion layer is proportional to the thickness of the layer. Prior to the present invention, Cr(III) conversion layers were limited to less than 80 nm, typically 20-60 nm thickness. These 20-60 nm Cr(III) conversion layers are typically referred to as "blue chromations" because of their inherent light blue color, and their characteristic blue optical iridescence. Beyond about 60 nm, the chromations lose their inherent blue coloration, and generally are no longer referred to as blue. Taking Klos' best example, a corrosion protection of ~66 hours until 5% white rust surface coverage (see Table 3 of Klos) is perfectly consistent with what would be expected of a classical blue chromation having a thickness at the upper end of the 20-60 nm range. Furthermore, at column 4 lines 61-64 of Klos it states that "[t]he solutions made in accordance with this example produced a blue passivation film with good corrosion resistance." What Klos teaches is a blue passivation layer "with good corrosion resistance;" that is, good for a blue passivation. However, to achieve the 100 to 1000 hours until *first attack* as recited in claims 1, 14, 20 and 24, higher conversion layer thickness is required than that of the blue chromations taught in Klos; e.g. greater than 60 or 80 nm in thickness.

To illustrate the difference between a classical blue chromation as in Klos (typical

corrosion protection of approximately 10-20 or 10-40 hours until first attack in the salt spray test) and a "chromitation" according to the present invention (providing corrosion protection of about 100 to 1000 hours until first attack), the Examiner is respectfully referred to Figs. 31 and 15 respectively of the present application. In Fig. 31, which shows measurements taken from a conventional blue chromation, the abscissa represents the depth in micrometers of the conversion layer, with the outer surface beginning from the left side of the figure at 0.0. The ordinate represents the concentration (in percent) of the referenced species. As can be seen from Fig. 31, for a blue chromation the Cr(III) concentration is high near the surface (up to about 22-23%) but rapidly decreases to zero before 0.1 μm . In contrast, Fig. 15 shows the corresponding concentration profile for a *chromited* conversion layer as claimed herein. As can be seen from Fig. 15, the Cr(III) concentration is much higher in the region adjacent the layer surface (~45% compared to 25% in Fig. 31), and Cr(III) penetrates much deeper into the conversion layer, up to 0.3 micrometers (300 nm) for the sample tested in Fig. 15. The conversion layer according to the invention is more robust than conventional blue chromations as in Klos, in that the Cr(III) species penetrates deeper into the layer and thereby affords longer corrosion protection than blue passivations, e.g. about 100-1000 hours until first attack as claimed. (It should be noted that the blue chromation represented in Fig. 31 was the best blue chromation that the inventors could make; typical blue chromations have even less Cr(III) penetration than is shown in Fig. 31).

In view of the above, Klos does not teach or suggest a conversion layer presenting the corrosion protection as recited in claims 1, 14, 20 and 24.

Bourke adds nothing to Klos in this respect. Bourke neither mentions chromium(III) conversion layers, nor the corrosion protection to be achieved by a chromium(III) conversion layer. Accordingly, it is respectfully submitted that the combination of Klos and Bourke does not disclose or suggest providing a conversion layer having the corrosion protection as recited in claims 1, 14, 20 and 24. Therefore, it is believed that the rejections of these claims have been overcome.

Independent claims 7, 10 and 28 each recite that the chromium(III) complex used for providing the chromium(III) conversion layer onto a metallic surface or zinc substrate has "ligand replacement kinetics more rapid than the fluoride replacement kinetics in chromium(III)-fluorocomplexes." The Examiner recognizes at page 4 of the Office action that "Klos does not provide any information about ligand replacement Kinetics involving

trivalent chromium.”

Instead, the Examiner has relied on Bourke to supply the necessary teaching for ligand replacement kinetics to support the rejection. Specifically, the Examiner states at page 5 of the Office action that Bourke “reported that trivalent Cr-fluoride complexes are kinetically very stable compared to other trivalent Cr-ligand complexes. See...pages 1580-1581....” Respectfully, Bourke contains no such teaching. The only mention of fluoride or chromium-fluoride complexes in Bourke is at page 1581, second column, where it states:

Recently, the structure and IR spectra of the analogous fluoride adduct $[\text{Cr}_3\text{O}(\text{O}_2\text{CC}_2\text{H}_5)_6\text{F}_3]^{2-}$ were reported. In comparison with other complexes containing chromium-fluorine bonds, it was shown that these bonds were the longest, and the stretching frequencies were the lowest, of any so far reported. The chromium-fluorine data provided evidence of a static trans effect. The present results demonstrate a kinetic trans effect. (Emphasis added, internal citations omitted).

Contrary to the Examiner’s suggestion, this passage does not disclose or suggest that chromium-fluoride complexes are kinetically stable compared to other trivalent chromium-ligand complexes. Rather, the recited fluoride complex (described as the “analogous fluoride adduct” to the trinuclear urea complexes examined in Bourke, e.g. $[\text{Cr}_3\text{O}(\text{O}_2\text{CCH}_3)_6(\text{urea})_3]^+$), is compared to other molecules containing chromium-fluorine bonds, and not to other chromium-ligand complexes in general. In other words, the reference does not compare the kinetics of chromium-fluoride to chromium-urea, but rather it compares the bond length and stretching frequencies of a particular chromium-fluoride complex to other molecules having chromium-fluoride bonds.

Bourke states that, compared to other chromium-fluoride bonds, those seen in the specifically described chromium-fluoride complex were the longest and had the lowest stretching frequencies. The reference makes no mention whatsoever of the replacement kinetics to be expected from any chromium-fluoride complexes, or the relative speed of such kinetics compared to other chromium-fluoride complexes or to other chromium-ligand complexes in general.

Contrary to the Examiner’s statement, Bourke nowhere discusses or mentions the stability of chromium-fluoride complexes. In fact, with regard to the specific chromium-fluoride complex disclosed at page 1581 of Bourke, it is a well known concept in chemistry that very long bonds are often highly susceptible to substitution reactions, which would tend to indicate that the disclosed chromium-fluoride complex is relatively unstable, quite the opp site of being “kinetically very stable” as suggested by the Examiner.

The only thing that is discernible from the cited passage in Bourke is that the authors apparently expected to observe a static trans effect in the disclosed chromium-fluoride complex, when in fact they experimentally observed a kinetic trans effect. This distinction relates to the geometric arrangement of the complex ligands in space, and does not suggest any relationship between the chromium-fluoride complex substitution kinetics and the kinetics of other chromium-ligand complexes.

Bourke does not undertake to compare the ligand replacement kinetics of chromium-fluoride complexes with other chromium-ligand complexes, such as the trinuclear chromium-urea complex disclosed therein. All Bourke is concerned with is describing, measuring and confirming the authors' statistical model for the kinetics and equilibrium of formation and dissociation of a very particular Cr-urea complex. Bourke describes a three-step kinetic process for the formation of this complex through a series of intermediates in three reported reactions. No comparison is made with the kinetics of chromium-fluoride complex substitution reactions, nor does Bourke provide any motivation for a person of ordinary skill in the art to undertake any such study or measurement.

Therefore, Bourke does not provide any teaching or suggestion of the claimed ligand replacement kinetics (in claims 7, 10 and 28), and the combination of Bourke and Klos does not provide, or suggest to a person of ordinary skill in the art to arrive at, the claimed invention.

Furthermore, even if Bourke is seen only as evidencing the level of skill in the art as the Examiner appears to suggest, the reference does not discuss or describe the relative ligand replacement kinetics between chromium-fluoride and other chromium-ligand complexes to indicate what the level of skill in the art might be. The Examiner states that it would have been obvious to "have selected suitable ligands to form trivalent Cr-ligand complexes in conversion coating solution compositions having ligand replacement kinetics greater than the replacement kinetics of fluoride complexes because [Bourke] provides sufficient information about suitable trivalent Cr-ligand complexes which exhibit usable ligand replacement kinetics." Office action, page 5. Respectfully, leaving aside the issue of whether the ligand replacement kinetics of the disclosed Cr-urea complex would be "usable" in the present invention (the reference is silent as to kinetic rates relative to Cr(III)-fluorocomplexes), there is no motivation from the reference or from Klos or elsewhere to actually make the combination. Klos is absolutely silent as to ligand replacement kinetics, as the Examiner has recognized, and as to any benefit to be achieved by using Cr-ligands having faster kinetics

than Cr(III)-fluorocomplexes. Therefore, Klos provides no motivation to seek out ligands having "usable kinetics" as the Examiner suggests because Klos fails even to recognize or disclose that replacement kinetics should be "optimized" or that replacement kinetics is a "result-effective variable" at all. Indeed, part of the Applicants' invention herein was to discover that ligand replacement kinetics are "result-effective" in providing chromium conversion layers having superior thickness and superior corrosion protection compared to conventional Cr(III) conversion layers previously known (e.g. blue chromations). To suggest in hindsight that a person could have achieved Applicants' invention by simply using ligands having "usable ligand replacement kinetics" is to use Applicants' own disclosure against their application. No one would have been motivated to use such ligands or even to select "suitable ligands" because, prior to the present invention, there was no recognized utility in doing so, nor was there any basis for making any such selection. The Cr(III)-ligand complex replacement kinetics simply were not recognized as being "result-effective" to produce superior chromations using only Cr(III) and not Cr(VI).


Still further, Applicants respectfully submit, the above notwithstanding, Bourke and Klos cannot be properly combined to support a rejection in the present application because a person of ordinary skill in the art would not be motivated, starting from Klos, to rely on or refer to Bourke to supply the claimed ligand replacement kinetics as recited in claims 7, 10 and 28. As discussed above, neither Klos nor the general knowledge of persons having ordinary skill in the art provided any teaching or suggestion that the ligand replacement kinetics of the Cr(III) complex should be "optimized" or even that it was a "result-effective variable" to produce superior Cr(III) conversion layers according to the invention. Moreover, Bourke does not provide or indicate any teaching to supply chromium-ligand complexes having particular replacement kinetics in order to produce an effective Cr(III) conversion layer. Rather, Bourke merely discloses a statistical model of kinetic equilibrium for the formation and dissociation of a particular Cr-urea complex, and reports experimental results confirming and explaining the authors' model as explained above. Therefore, Bourke also does not supply any motivation or suggestion to combine that reference with Klos in order to achieve a more effective chromium(III) conversion layer. Accordingly, there being no motivation either in Klos, Bourke or in the general knowledge of persons having ordinary skill in the art at the time the invention was made, to combine Bourke with Klos, that combination is improper and cannot support a rejection of the claims herein under Section 103.

Furthermore, even if the combination is seen as proper, for the reasons described above the combination of Klos and Bourke does not teach, disclose or suggest a chromium(III) conversion layer that is chromium(VI)-free, made using a "chromium(III) complex having ligand replacement kinetics more rapid than the fluoride replacement kinetics in chromium(III)-fluorocomplexes" as claimed. Consequently, the rejections of claims 7, 10 and 28 are now overcome, and are believed to be allowable.

In view of all of the above, it is respectfully submitted that the rejections of claims 1, 7, 10, 14, 20, 24 and 28 have all been overcome, and are thus now allowable. All remaining claims are dependent claims and should therefore also be allowable as depending from an allowable base claim.

If there are any fees required by this communication not mentioned above, please charge such fees to our Deposit Account No. 16-0820, order No. 31716US1.

Respectfully submitted,
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7. (twice amended) A method for producing a chromium(VI)-free conversion layer affording at least the corrosion protection of conventional chromium(VI)-containing yellow chromations, wherein a metallic surface is treated with a solution of at least one chromium(III) complex and at least one salt; ~~said method being further characterized in that the concentration of the chromium(III) complex is increased in comparison with a conventional trivalent blue chromation; and/or a said chromium(III) complex is used having~~ ligand replacement kinetics more rapid than the fluoride replacement kinetics in chromium(III)-fluorocomplexes; ~~said chromium(III) complex being present in said solution~~ in a concentration of 5 to 100 g/l, said method producing a chromium(VI)-free conversion layer ~~affording at least the corrosion protection of conventional chromium(VI)-containing yellow chromations.~~

10. (twice amended) A concentrate for producing a passivation solution for surfaces of zinc or zinc alloys, ~~said concentrate substantially containing chromium(III) for a~~ passivating component, wherein the chromium(III) is present in the form of at least one complex having ligand replacement kinetics more rapid than the fluoride replacement kinetics in chromium(III) fluorocomplexes, said concentrate being chromium(VI)-free.

24. (twice amended) A conversion layer obtained by a method comprising the steps of immersing a metal surface of zinc or zinc alloy, for an immersion period, in a passivation bath comprising chromium(III) as a passivating component, wherein chromium(III) is present in a concentration of about 5 to 100 g/l, and thereby providing said conversion layer on said metal surface, said conversion layer and said passivation bath each being chromium(VI)-free, said conversion layer presenting a corrosion protection of about 100 to 1000 h in the salt spray test according to DIN 50021 SS or ASTM B 117-73 until first attack according to DIN 50961 Chapter 10.

28. (third amended) A conversion layer obtained by a method comprising treating a metallic surface of zinc or zinc alloys with a solution of at least one chromium(III) complex and at least one salt, ~~wherein the concentration of the chromium(III) complex in said solution is increased in comparison with a conventional trivalent blue chromation; and/or a said~~ chromium(III) complex is used having ligand replacement kinetics more rapid than the

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fluoride replacement kinetics in chromium(III)-fluorocomplexes, said solution being chromium(VI)-free.

37. (amended) A conversion layer according to claim 21, having a chromium index greater than 10, the chromium index being defined as the average chromium content in said conversion layer greater than 1% chromium, multiplied by the thickness of said conversion layer.

46. (amended) A ~~passivation bath method~~ according to claim 21, said immersion period being between about 15 and 100 seconds.